

A Grid Proxy Architecture for Network Resources

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Agenda

- **Challenges**
- **Grid Proxy Architecture for Networks (GPAN)**
- **Demo**
- **Summary**

Grids and Networks

- **Network is an integral part to Grids**
 - Network resources guarantee Grid resource sharing
 - Networks resource allocation needed to effectively enable distributed virtual organizations (VOs)
- **Networks are heterogeneous in nature**
 - Different kinds of devices and vendors
 - Domain-specific clouds in separate administrative domains
 - Unknown number of network layers and elements in a p2p connection
- **Networks have their own standards and evolution curve, not necessarily grid savvy**
 - Standards and architectures defined in IEEE, IETF, ITU and others
 - Data plane, control plane, and management plane protocols
 - Network services provided for management and control

- **For Grids to be successfully deployed across LAN/MAN/WAN, we need a rich 2-way interaction between Grid and Nets**
 - **Networks are unaware of Grid concepts and services**

Challenge: Grid Management of Network Resources

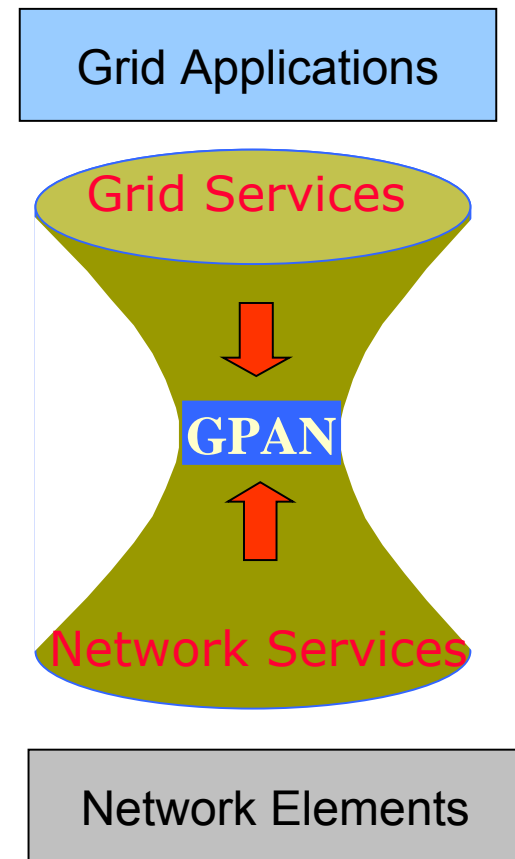
- **Current network services do not match Grid Resource requirements**
 - E.g., reporting resource status into MDS/Index
 - E.g., allocating resources based on GRAM/RSL request
- **Network elements individually may not be able to offer Grid compatible resource services**
 - Limited CPU, memory, embedded system environment
 - Ineffective allocations of element resources when shared by multiple VO's
- **Grid deployment over legacy and varied networks**
 - Optical, Ethernet, IP, FR, ATM networks do not all offer same resources
 - Legacy network elements cannot be grid enabled

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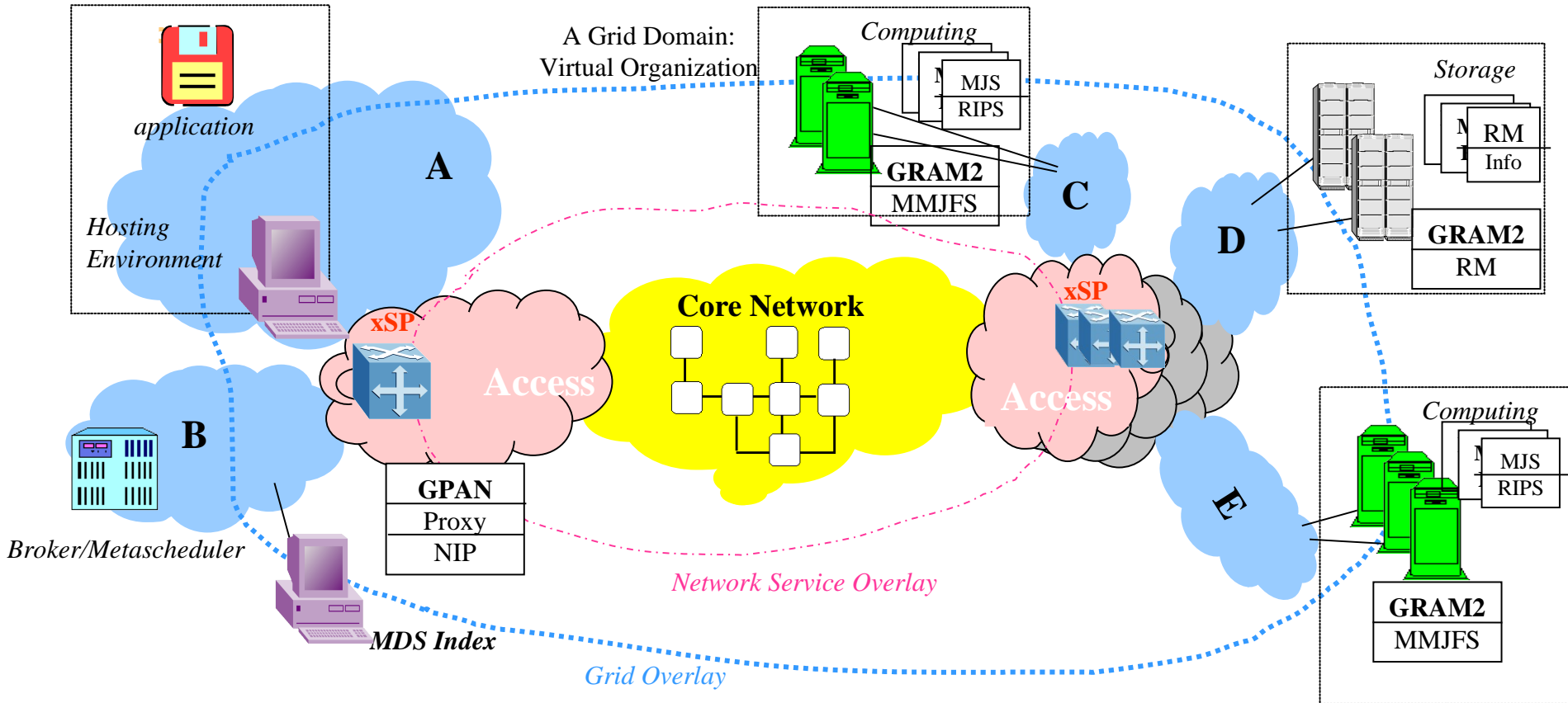
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Grid Proxy Architecture for Network Resources (GPAN)

- **Enables Grid Resource Services to take advantage of existing network services**
- **The GPAN Grid middleware functionality includes:**
 - Proxy for accepting Grid resource requirements
 - Provider of information regarding network resource availability/status
 - Co-existence and integration with GRAM2, MDS
 - Support for RSL2 extensions featuring network resource allocation capabilities
 - OGSi-services providing network resource info & dynamic allocation capabilities
 - Abstract view and access to base network services

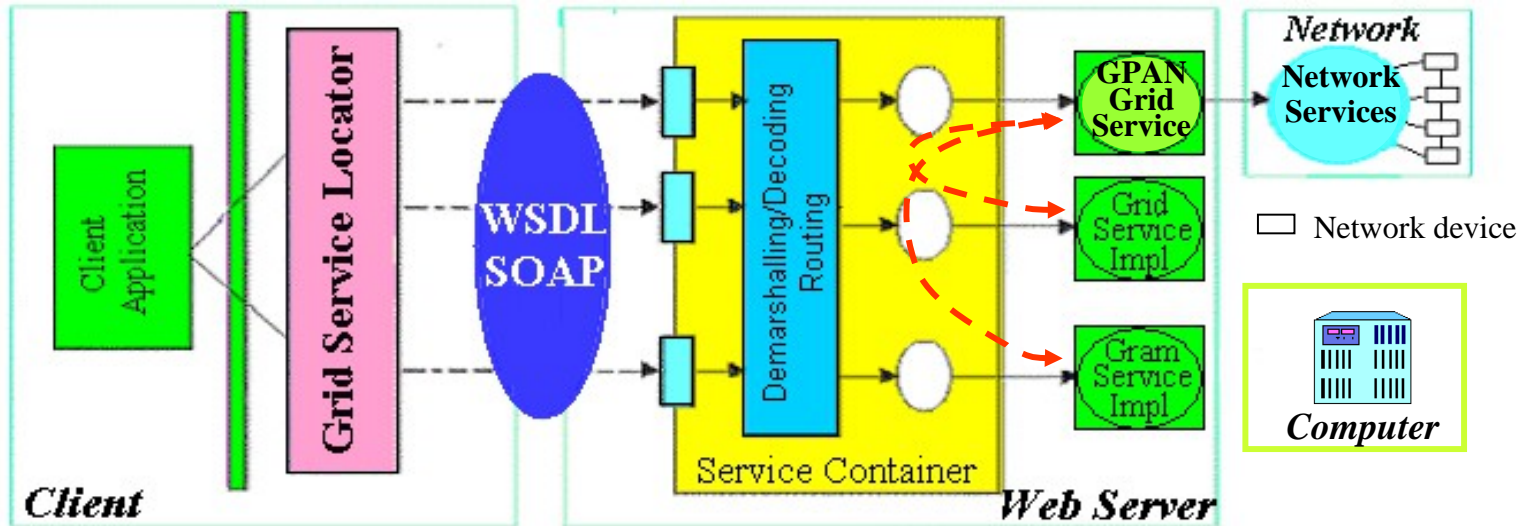


Grid Resources: general setup



- A Grid VO utilizes grid resources in Campus A-E
- Service Providers (xSP) on MAN/WAN access networks peer together to provide required network services to the Grid VO.
- Index services collect resource information from computing, storage resources in Campus A-E and xSP
- Broker/metascheduler performs resource lookups and allocations of all grid resources for applications

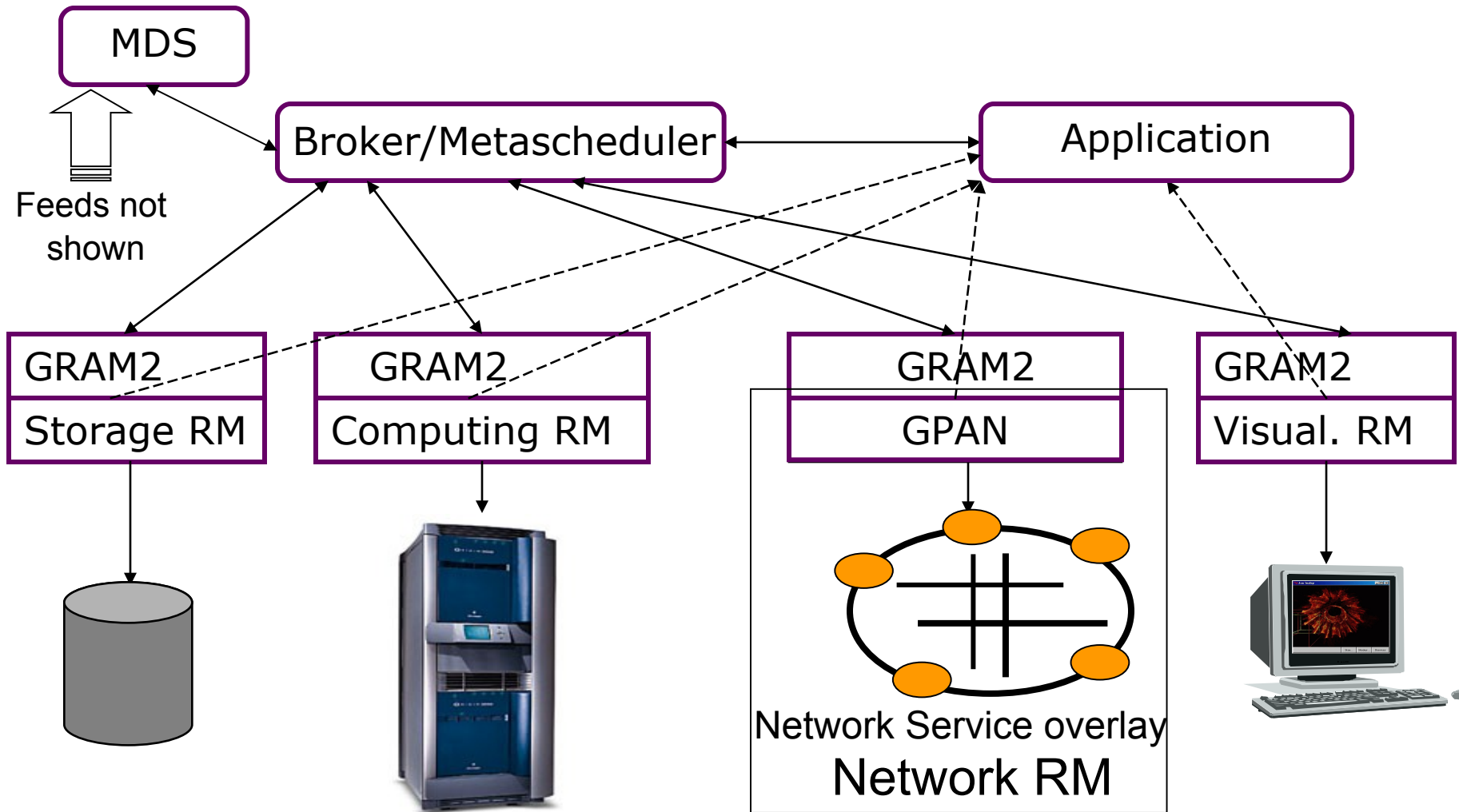
Proxy architecture implements scalable resource services for networks



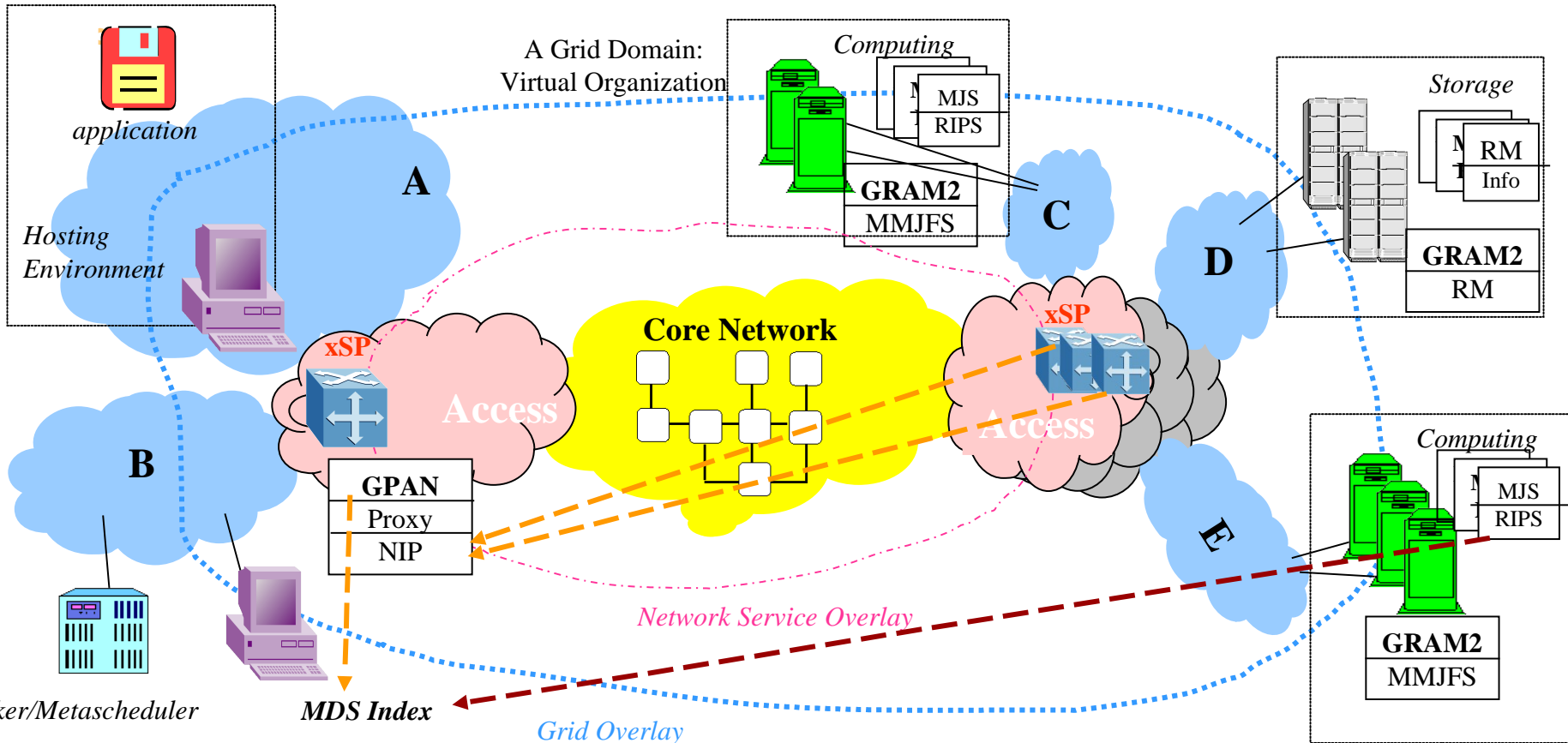
- **GPAN Grid Service**

- Provides a GRAM-2 instance in a network
- Extends RSL2 for network resources
- Supports resource discovery and info updates on the Grid
- Supports resource dynamic provisioning, optimization
- Resource Services such as GRAM talks to GPAN for network resource requests
- Grid clients and services use GPAN WSDL interface

Resource Management Flow

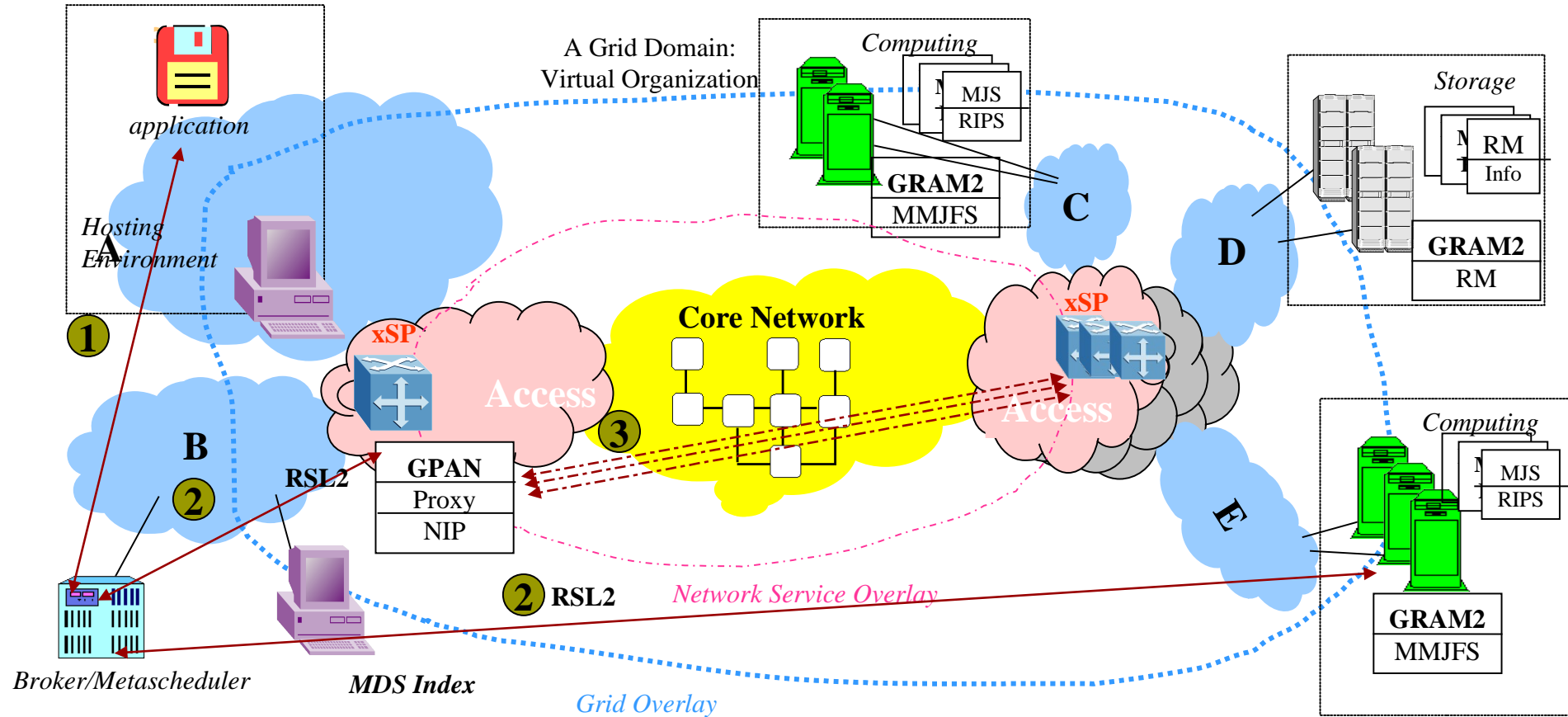


Network Resource Information using GPAN



- **GPAN provides network info to MDS/Index**
 - Proxy for network resource allocation status and updates
- **Network Info Provider (NIP) aggregates resource discovery and status updates**
 - Based on virtual network topology related to the VO

Network Resource Allocation using GPAN



- 1) Application requests broker/metascheduler for job services and resources
- 2) Broker/metascheduler generates RSL2 for resource allocation requests after consulting MDS/Index
- 3) xSPs co-ordinate to allocate requested resources

GPAN Programming Model

- **Two service infrastructures involved**

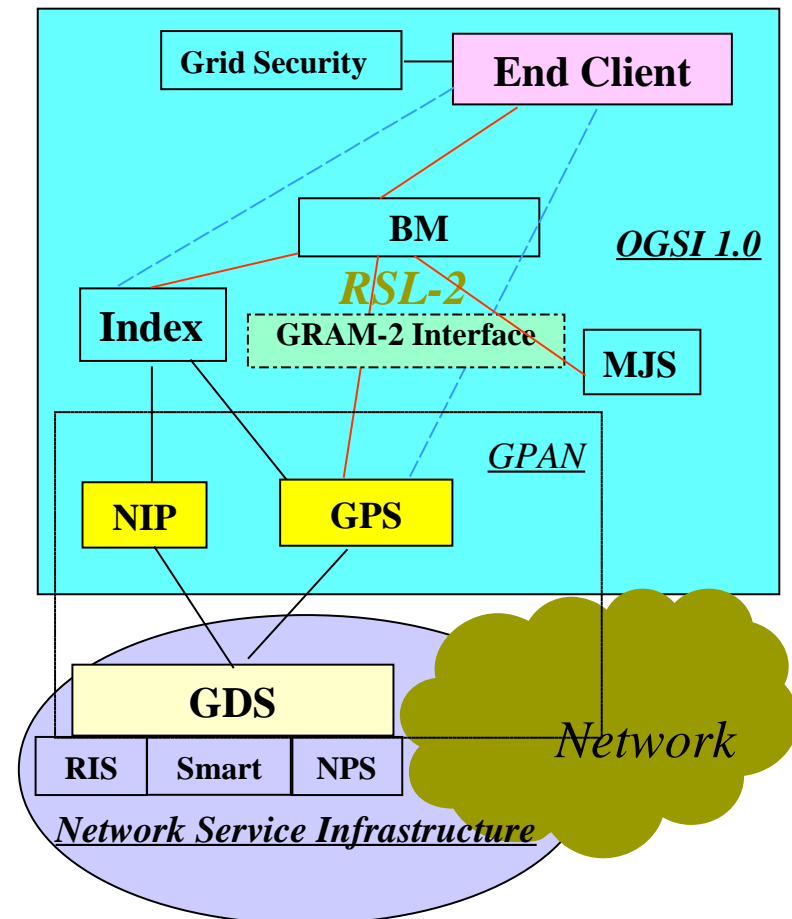
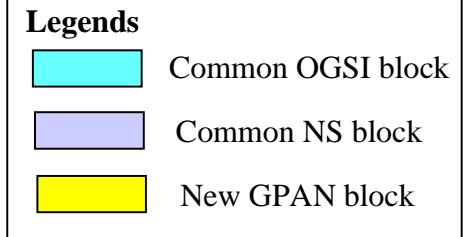
- OGSi: Grid services
- NS: network services

- **GPAN Service Components**

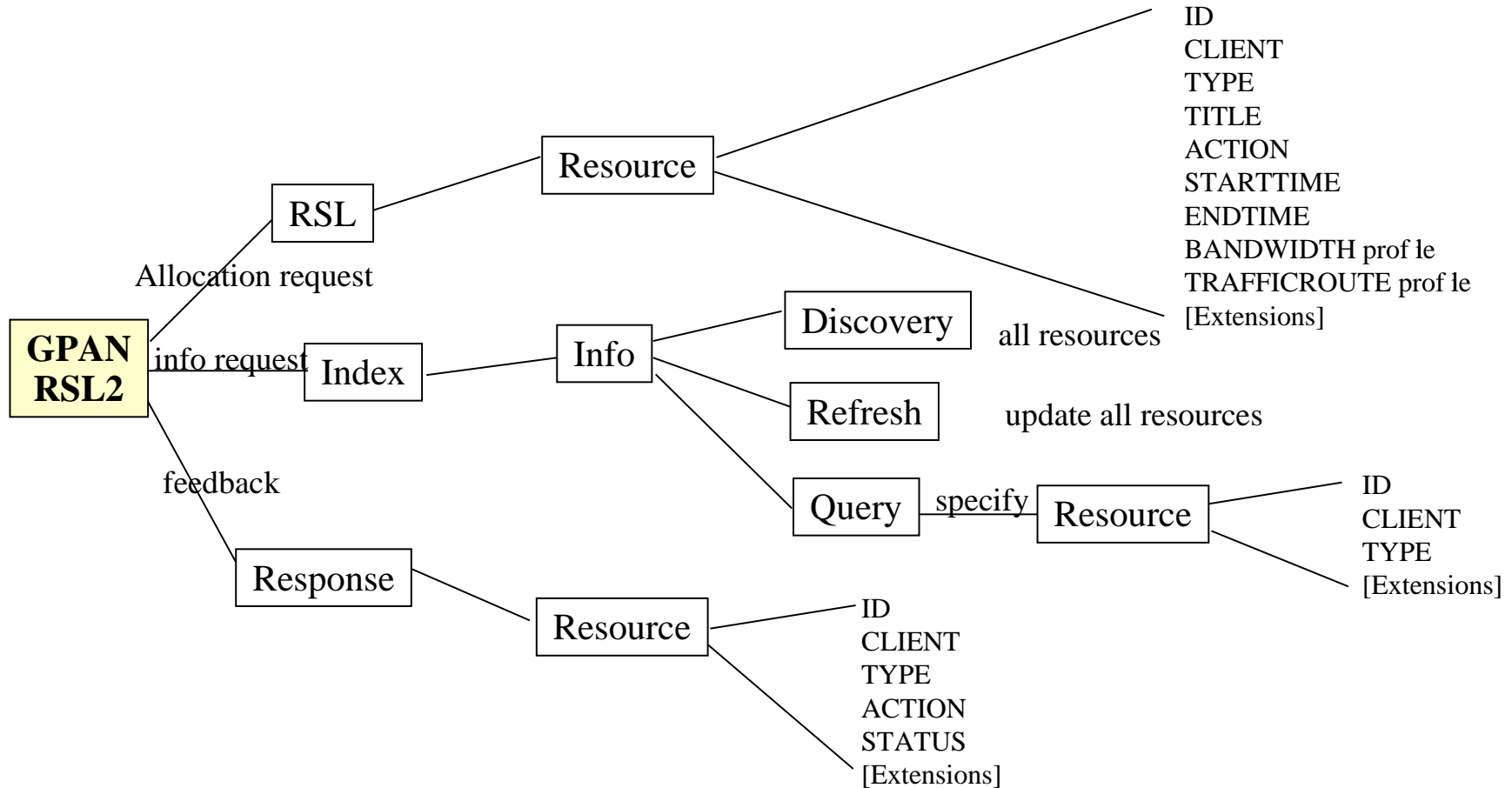
- GPS: GPAN proxy
- NIP: GPAN network info provider
- GDS: GPAN delegation
- Smart: NS intelligence
- NPS: NS network provisioning
- RIS: NS network discovery and info update

- **Other Service Components**

- BM: Broker/Metascheduler
- MJS: Managed Job Service



GPAN RSL2 extension



- **GPAN RSL2 is defined in terms of XML and schemas**
- **GPAN RSL2 is used for resource allocation, info and feedback**
- **GPAN RSL2 is fully extensible**

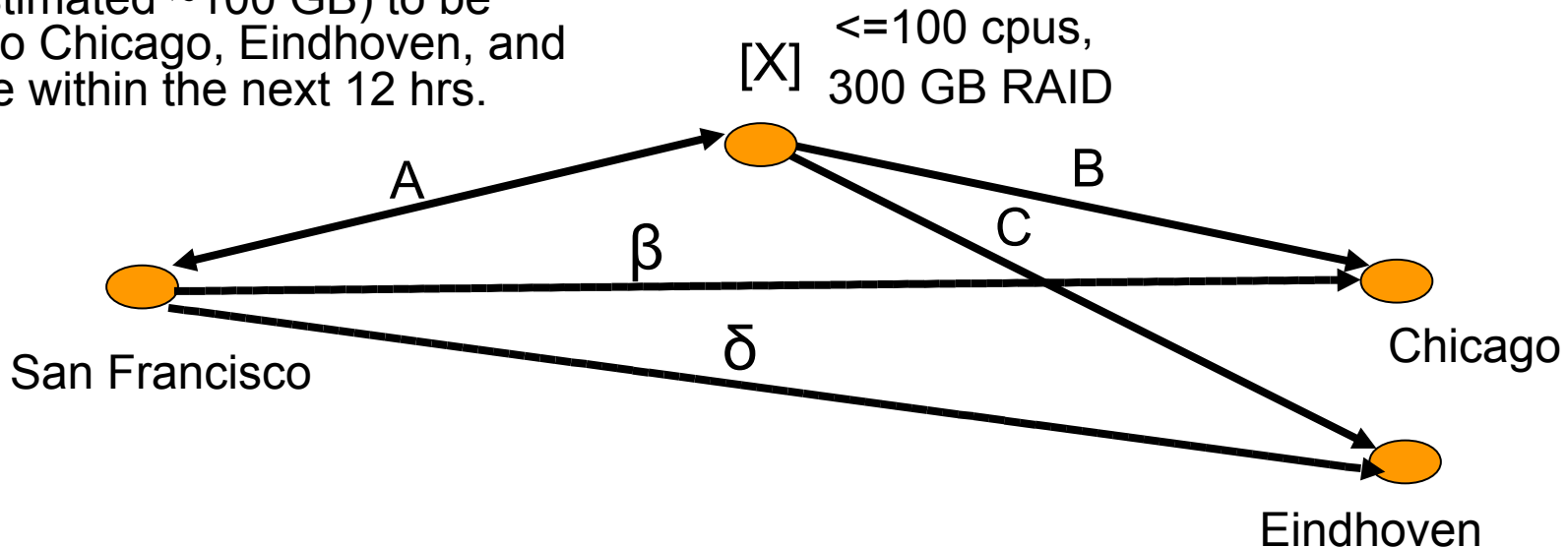
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Bandwidth Boost Notional Picture

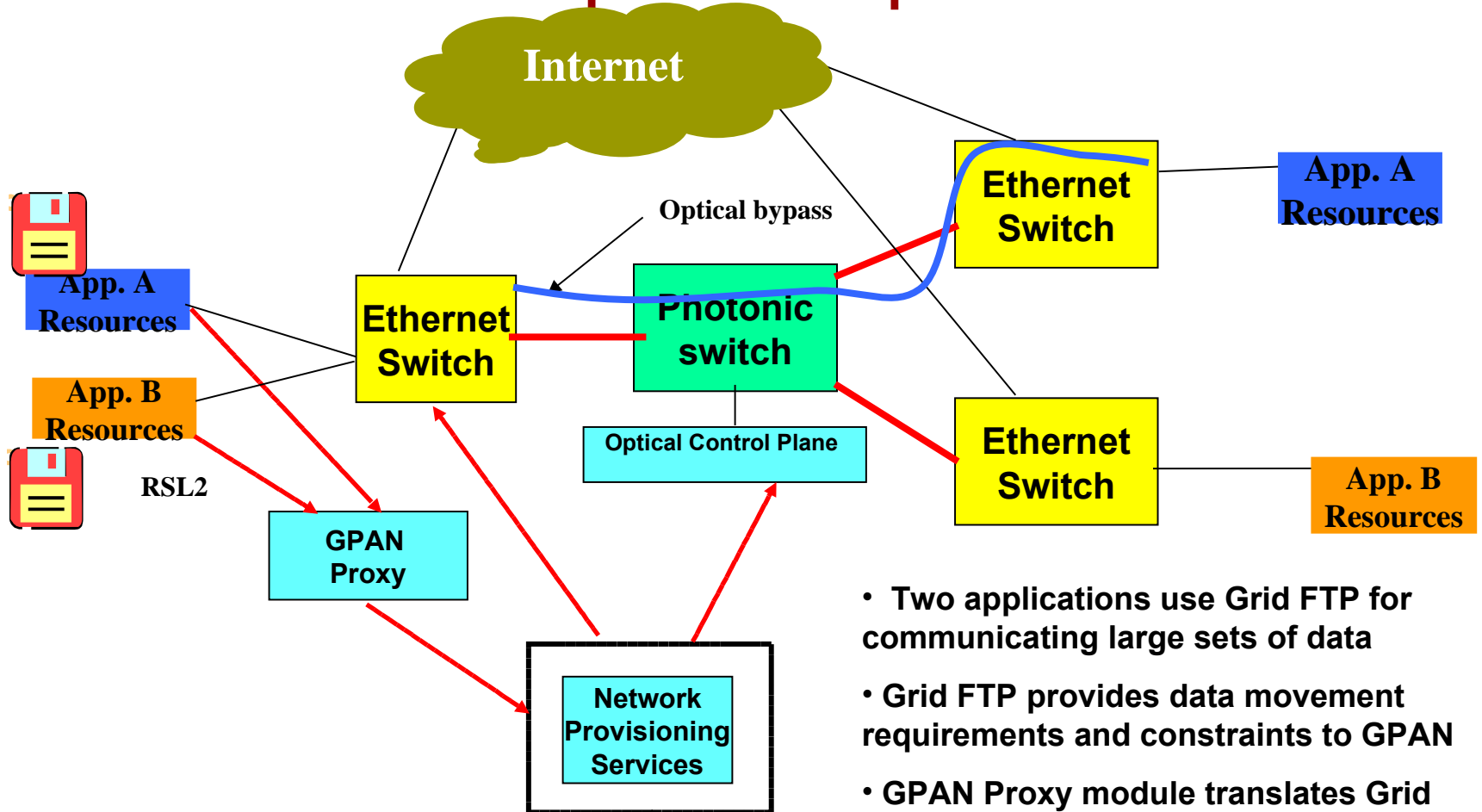
1. I'm in San Francisco. I need this application of mine to munch on a 200 GB data set. Elapsed time is a known function of Ω/N , with Ω a manifest constant and N the number of processors ≤ 100 . I need the result (estimated ~ 100 GB) to be shipped to Chicago, Eindhoven, and back here within the next 12 hrs.

2. That is, I *anycast* everything but the final destination(s)



3. Infrastructure decides $[A,B,C]$ vs. $[A,B,\delta]$ vs. $[A,\beta,\delta]$ vs. [others] according to which Location $[X]$ s complies and which optical by-passes $[A,B,C,\beta,\delta]$ can be set at times t_0 and $t_0+f(\Omega/N)$. Proceed to reserve Location $[X]$ with the chosen optical by-passes (all or none).

“A Globus-based Grid Infrastructure Negotiates Ephemeral Optical Bandwidth Boost”



- Two applications use Grid FTP for communicating large sets of data
- Grid FTP provides data movement requirements and constraints to GPAN
- GPAN Proxy module translates Grid requirements to appropriate network resource allocation
- GPAN Proxy module works with Network provisioning services to allocate optical by-pass as shown.

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Related Work

- **GARA, DUROC**
 - Concept of Resource co-allocation, scheduler, advanced reservations leveraged in our work
 - GPAN extends the reach of GARA/DUROC concepts
 - Job Manager in GPAN refers to GRAM2 and its instances
- **WS-Agreement**
 - Services and resource lifetime-management and policy-based negotiations between network domains
- **GRAM/RSL/JSDL**
 - Extend RSL2 to work with GPAN for network resources
 - JSDL is new standard being discussed @GGF for job submissions

Relevant Standards Activities

- **Global Grid Forum**
- **DMTF**
 - CIM schemas for network devices and end-to-end services
- **OIF**
 - New UNIs
- **IETF/IRTF**
 - Policy, AAAs
- **ITU**
 - VPNs, (E)NNIs, GMPLS
- **OASIS, W3C**
 - Evolution of WS technologies

Summary

- **GPAN leverages existing network service facilities for Grid resource provisioning**
 - Grid applications needs not to use or know about network services
 - Current network services need not to be modified for Grids
 - GPAN exploits network smart services for Grid applications
 - No Grid service is deployed on any particular network element
- **GPAN Achievement**
 - Support of OGS1 1.0, GT3 implementation
 - Extensions to RSL2 for network resource info and allocation
 - GT3 integration with MDS/Index
 - Built on Nortel's extensible network service platform
 - Can run over hybrid optical + IP networks
 - Live demo at GW04!